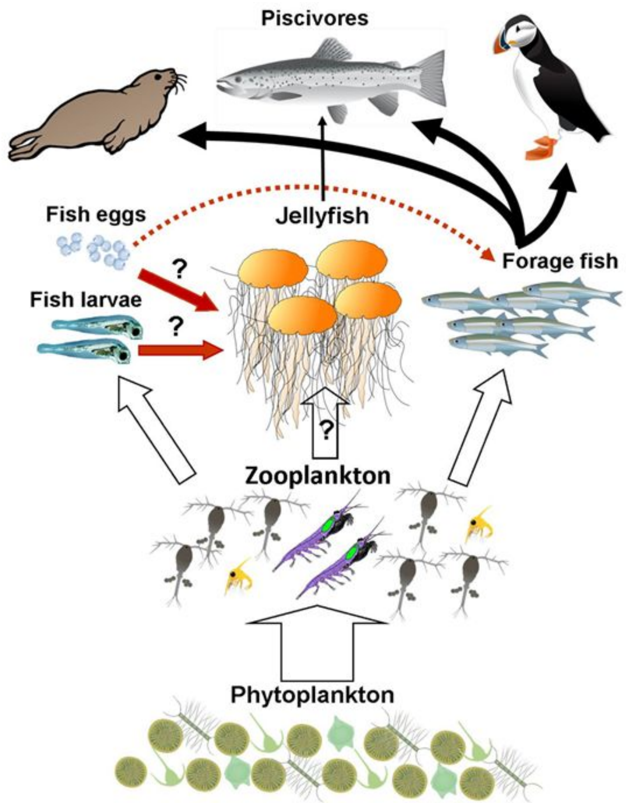
Food Habits and Diet

Wesley Strasburger

NOAA FISHERIES

Alaska Fisheries Science Center

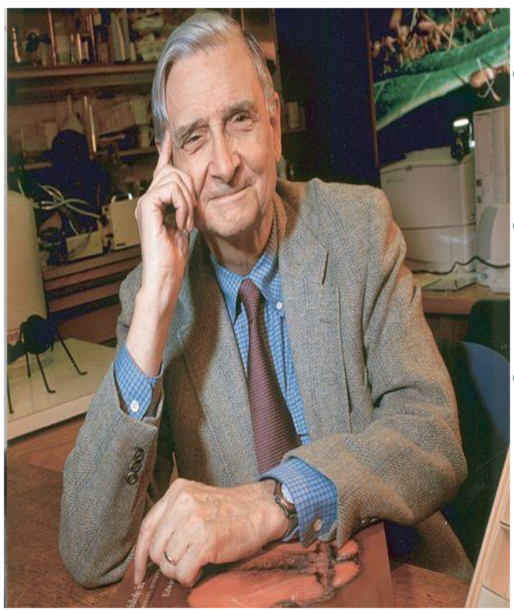


Courtesy M.B. Decker

Ecosystem Science Review
Juneau, Alaska
May 2-6, 2016

A Brief History of Ecology

- ~350 BC, Aristotle produces the first preserved writings of the idea of ecology
- Early 18th century, Francis Bacon develops "Imperial Ecology"
- Mid 19th century, Charles Darwin states ecology is the driving force for evolution
- 1990, E.O. Wilson publishes "The Ants"



Overview: Status of Ecosystem Data

- Long term data sets
- Many species, age structure for some
- All LME in Alaska
- Fish
- Marine Mammals
- Seabirds

Rob Endsley, POW Sport

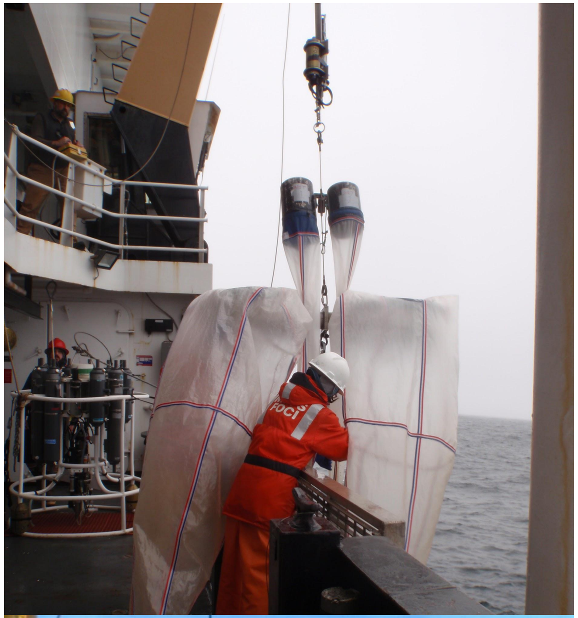
Julia Harvey, TAS

Overview: Status of Ecosystem Data

- Suite of physical and biological covariates

- Physical
  - *Temperature*
  - *Salinity*
  - *Beam Transmission*
  - *Dissolved Oxygen*
  - *Nutrients*

- Biological
  - *Chlorophyll a*
  - *Zooplankton 505*
  - *Zooplankton 153*



REEM Protocols

- Collections of post-juvenile fish 1982-present, focus on commercial-sized fish, 1,000,000+ predator/prey interactions recorded.
- Primary collection from Bottom Trawl Surveys, secondarily observer samples, acoustics surveys.
- Samples are ~50/50 scanned on deck versus returned to lab in formalin.
- Primary purpose is construction, fitting, and updating of multi-species models with commercial predators and prey.

Stomach Examiner's Tool

Resource Ecology and Fisheries Management Division

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Eunice valens (Family Eunicidae)

Welcome to the Stomach Examiner's Tool (SET). Here, we present information that is useful when performing stomach content analysis of marine fish collected in Alaskan waters; the eastern Bering Sea, Gulf of Alaska, and Aleutian Islands. The information provided here should also be helpful for analysts working on the food habits of marine fish in the coastal waters of Washington, Oregon, and California.

The Food Habits Laboratory of the Alaska Fisheries Science Center (AFSC) Resource Ecology Ecosystem Modeling Program (REEM) has been collecting data on the food habits of commercially and non-commercially important fish species since the early 1980s. Over the 30+ years of processing stomach contents, we have accumulated a wealth of taxonomic information that is useful for identifying prey found in marine fish stomachs. We have used a digital camera to record the distinguishing taxonomic features of whole specimens, partially digested specimens, gill arches, vertebrae, postcleithrum, otoliths, telson of crustaceans, subopercle and preopercle of fish, setae of polychaetes, and other slow digesting hard parts. The objective of this web site is to provide the comprehensive information as a guide for stomach content analysts to identify the prey items in marine fish stomachs quickly and easily. Prey images and data presented here include pelagic (water column) prey such as zooplankton, small forage fish, juvenile and adult groundfish and benthic prey (on the sea floor) prey such as shrimp, crab, juvenile and adult groundfish, marine worm, amphipods, clams and snails.

- Focus on prey length, count, size, especially of commercial prey (pollock, crabs, octopus).
- Less detail in plankton prey.
- Online ID tools, manuals, interactive diet maps.
- Substantial raw data release with press coverage in 2016.

EMA Protocols

At sea protocol

Rapid assessment

Diets are pooled within stations

Methods are weight based, no counts

Fine detail in zooplankton identification

Used to evaluate age-0 groundfish and forage fish response to environmental change

2003 - 2015 eastern Bering Sea

2015 forward eastern Gulf of Alaska

Alaska Fisheries Science Center | Resource Assessment and Conservation Engineering (RACE) Division
Resource Ecology and Fisheries Management (REFM) Division

RACE/REFM Seminar

February 24, 2015, 10–11 a.m.

NMML Conference Room
Bldg 4, Rm 2039

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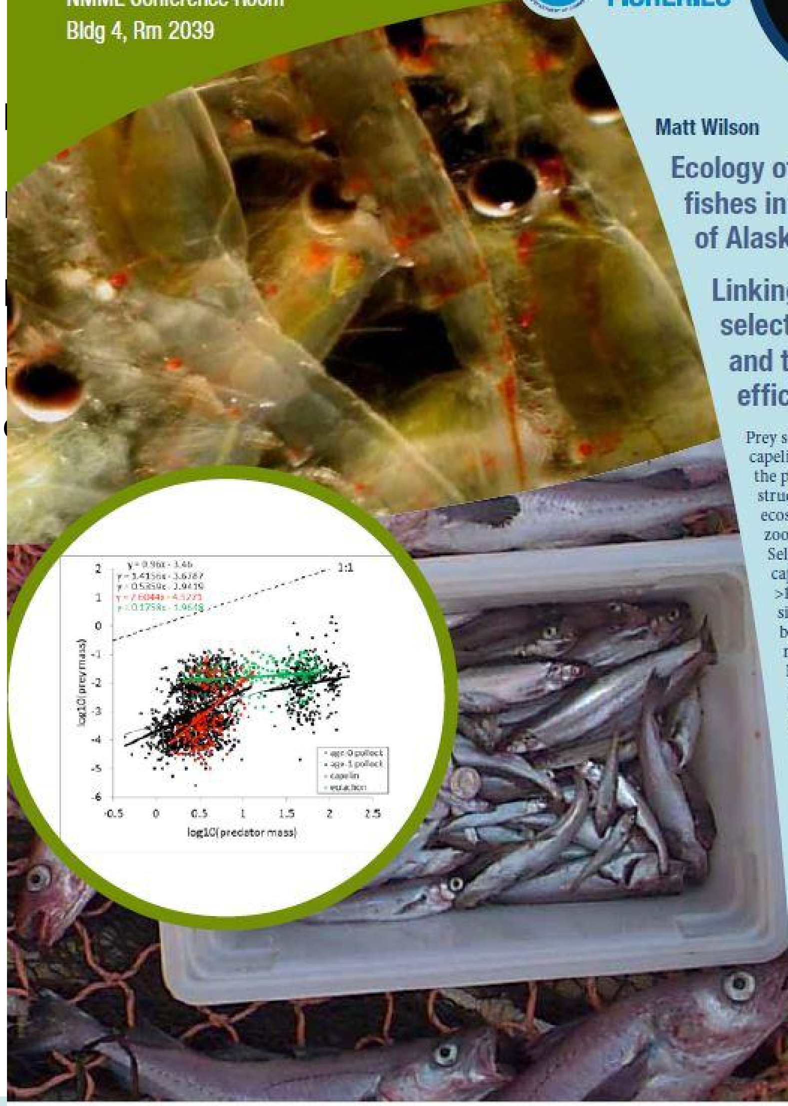


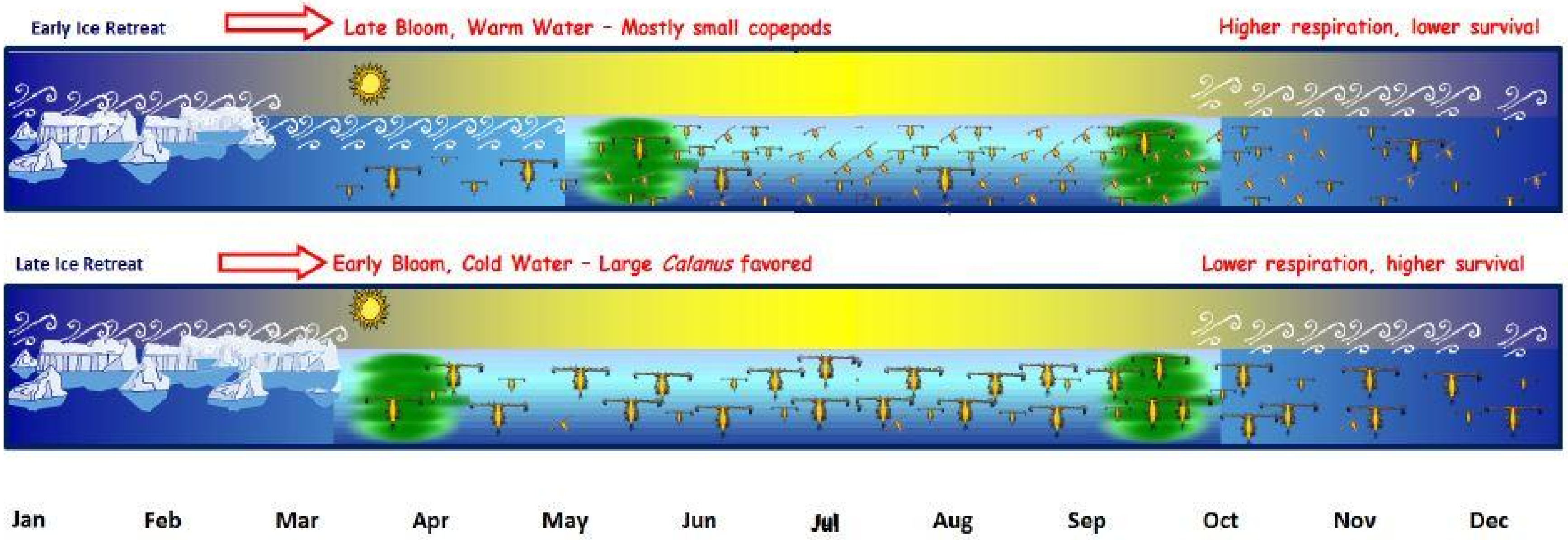
Matt Wilson

Ecology of small neritic fishes in the western Gulf of Alaska

Linking predator selectivity to prey size and trophic transfer efficiency

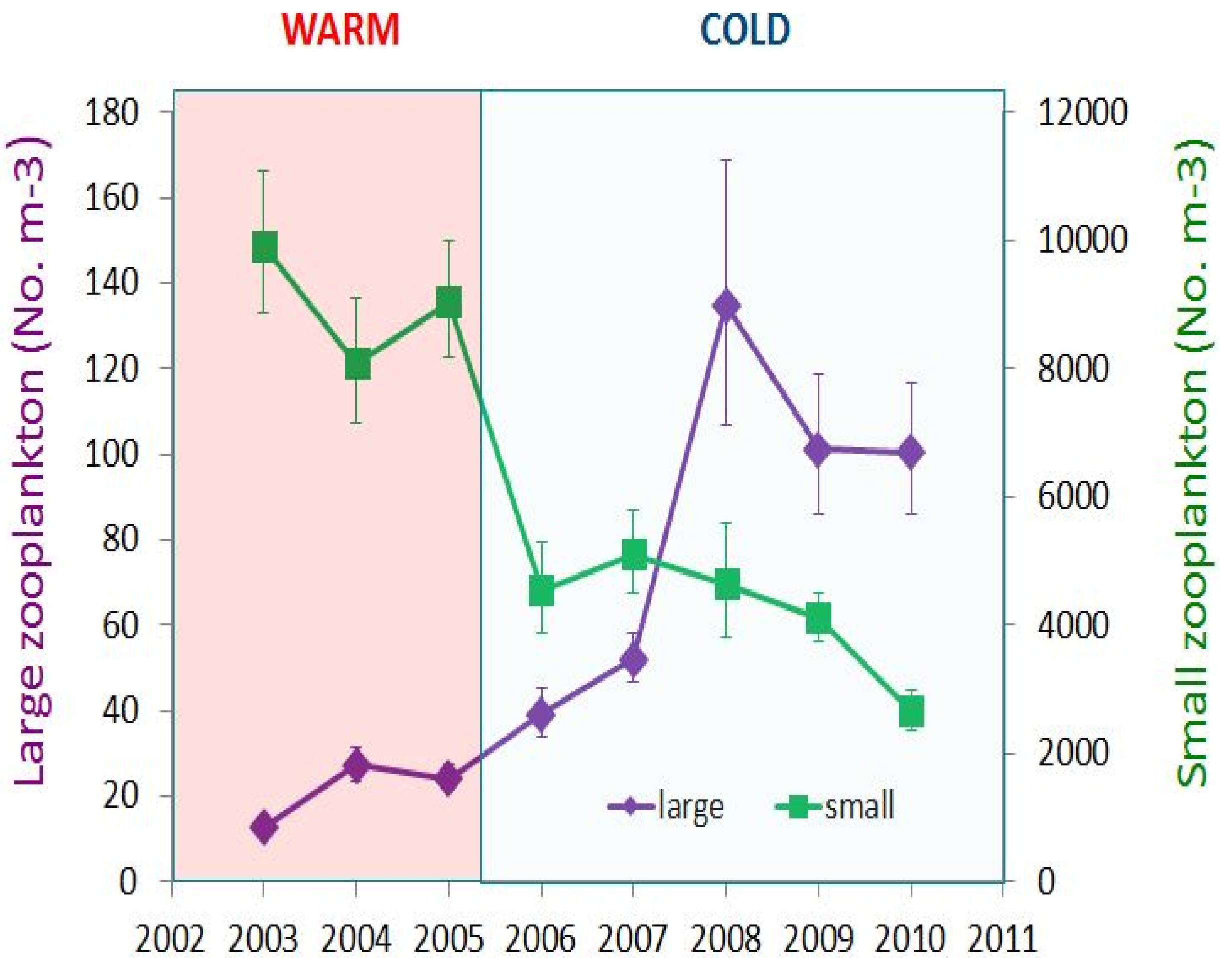
Prey selection by juvenile pollock, capelin, and eulachon helps support the predator-dominated trophic structure of the Gulf of Alaska ecosystem. These fishes select zooplankton partly on body size. Selection by age-0 pollock and capelin resulted in steep (slope >1) logarithmic predator-prey size relationships. Selection by older pollock and eulachon resulted in low-slope (<1) logarithmic predator-prey size relationships. Observed predator-prey mass ratio theoretically implies that at 10 g these predators would produce about 75 mg for every 1 g produced by their prey, and that capelin and eulachon tend to be more efficient than pollock due to relatively low PPMR.

Sea ice and ecosystem function

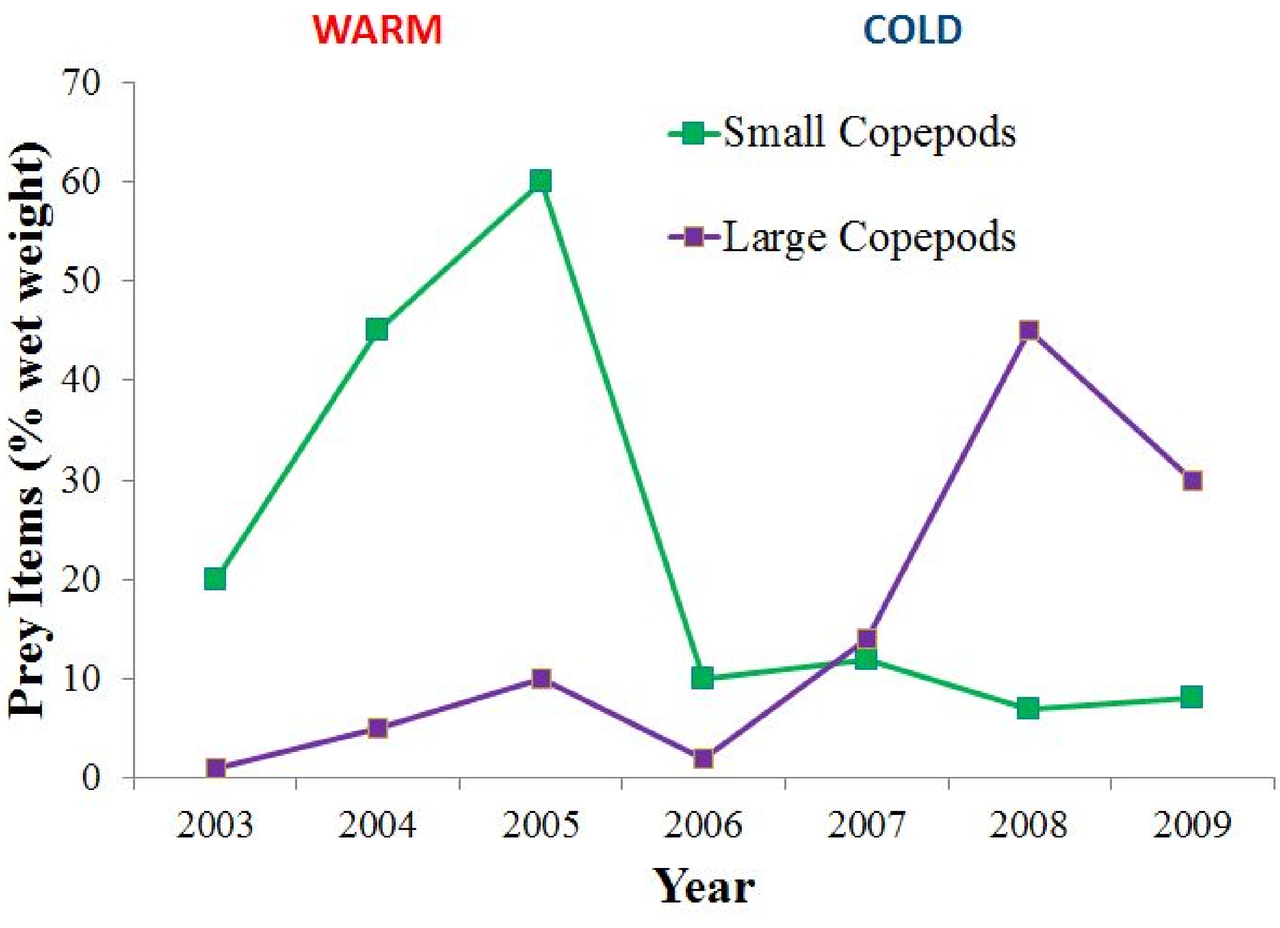


Hunt et al., 2011; Coyle et al., 2011,
Sigler et al., 2016

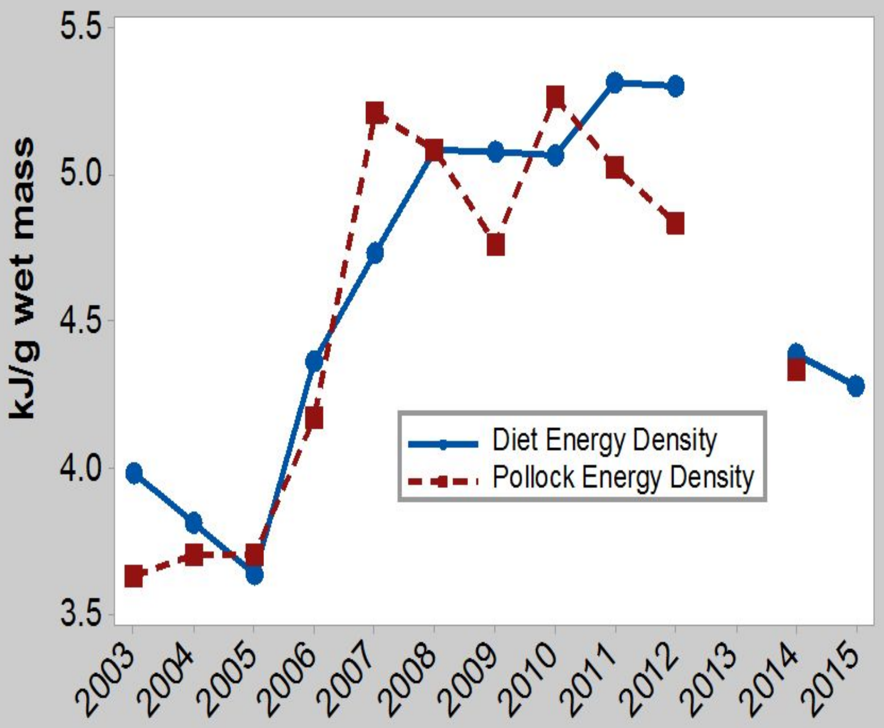
Late Summer (Aug – Oct) Zooplankton Biomass Switched from Small to Large Species

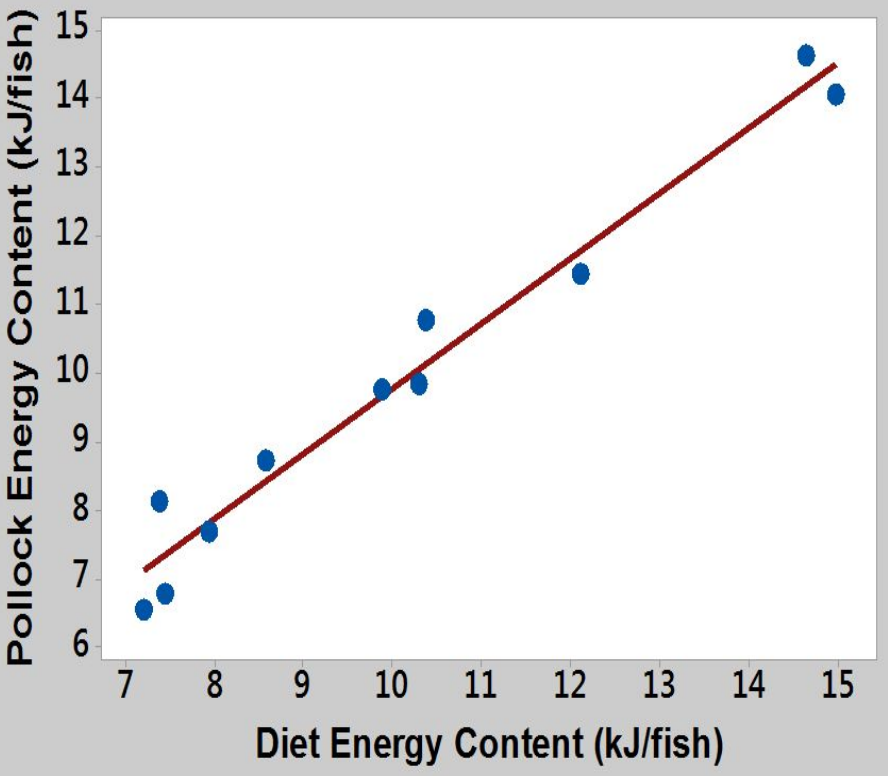


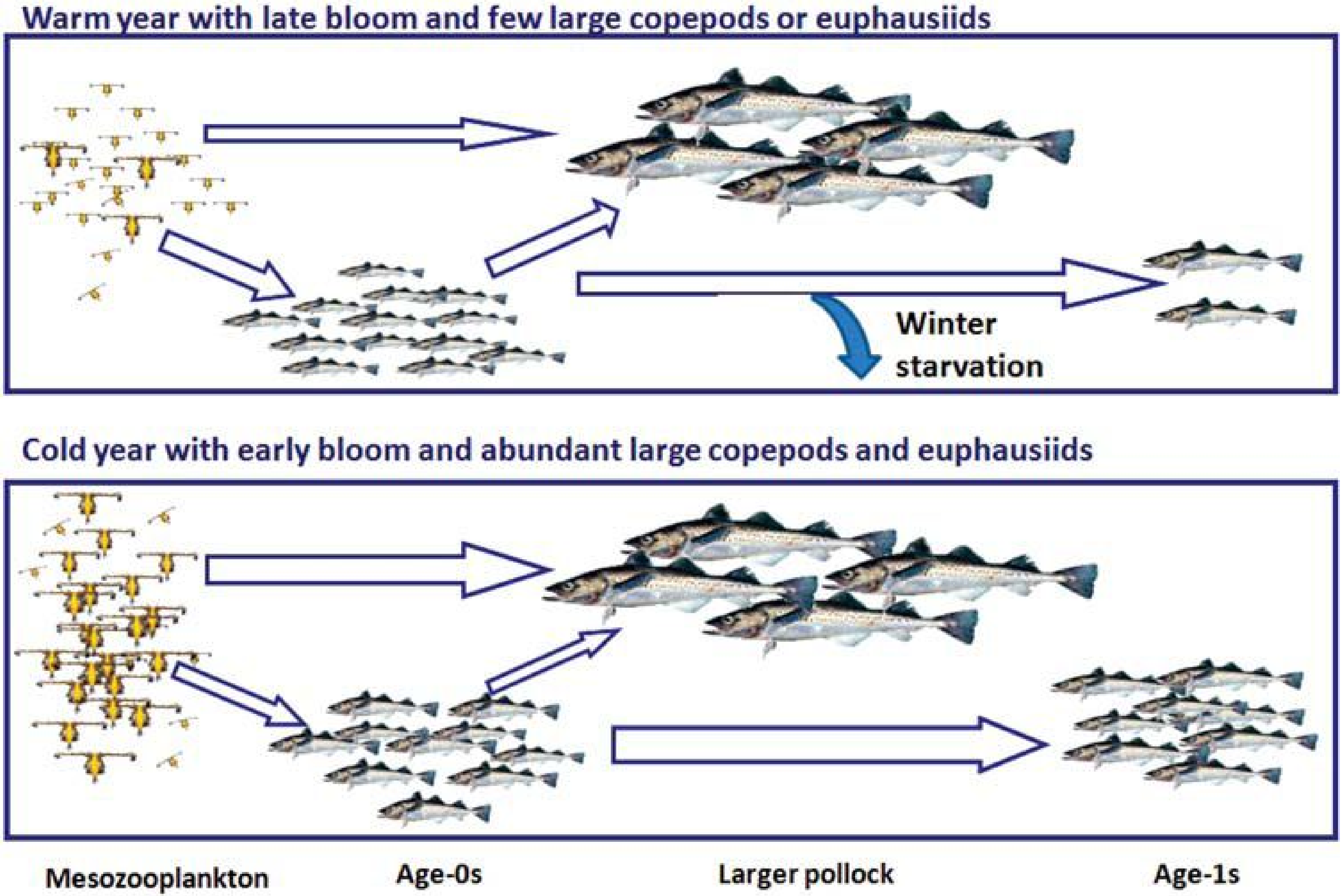
Subsequent Changes in Age-0 Pollock Diet in Southeast Bering Sea (Aug – Oct)



Higher Lipid Content in Zooplankton During Cold Years (Aug – Oct)






Warm year with late bloom and few large copepods or euphausiids
Winter
starvation
Cold year with early bloom and abundant large copepods and euphausiids
Mesozooplankton
Age-0s
Larger pollock
Age-1s

Forage Fish

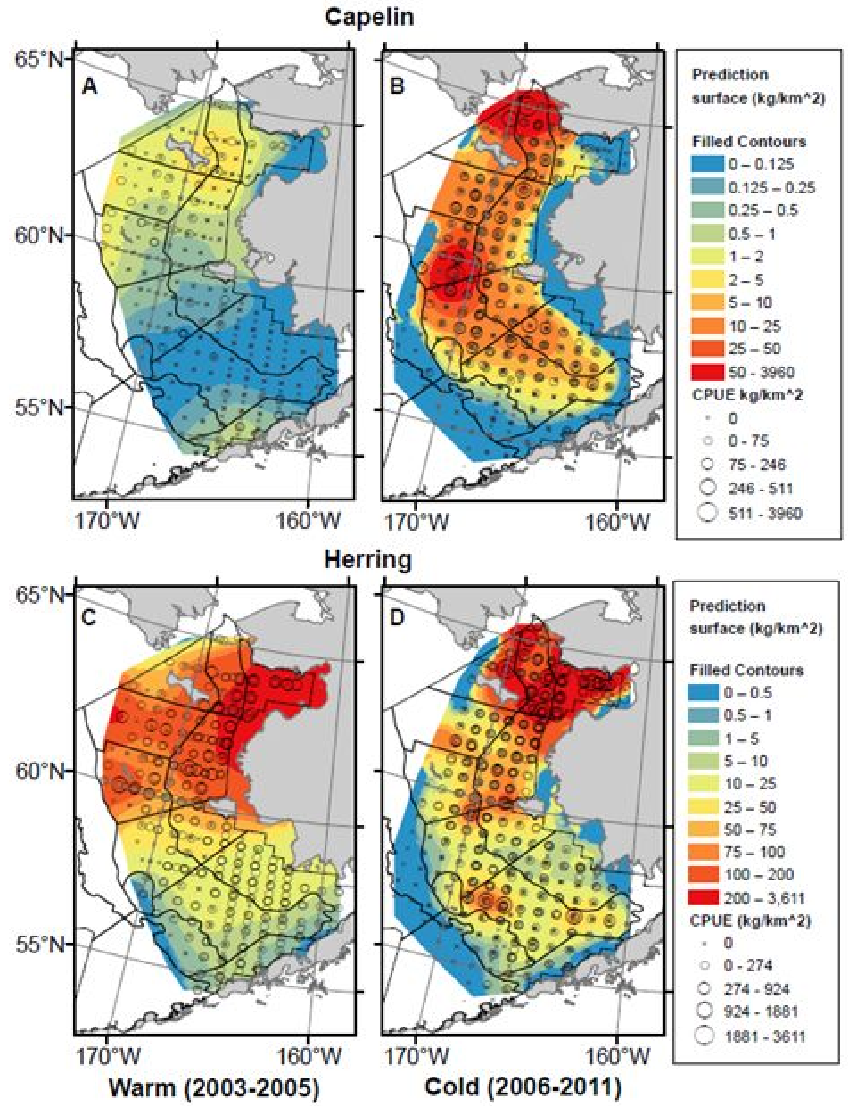
Shifts in distribution

Capelin:

Significant retraction and reduction in warm years

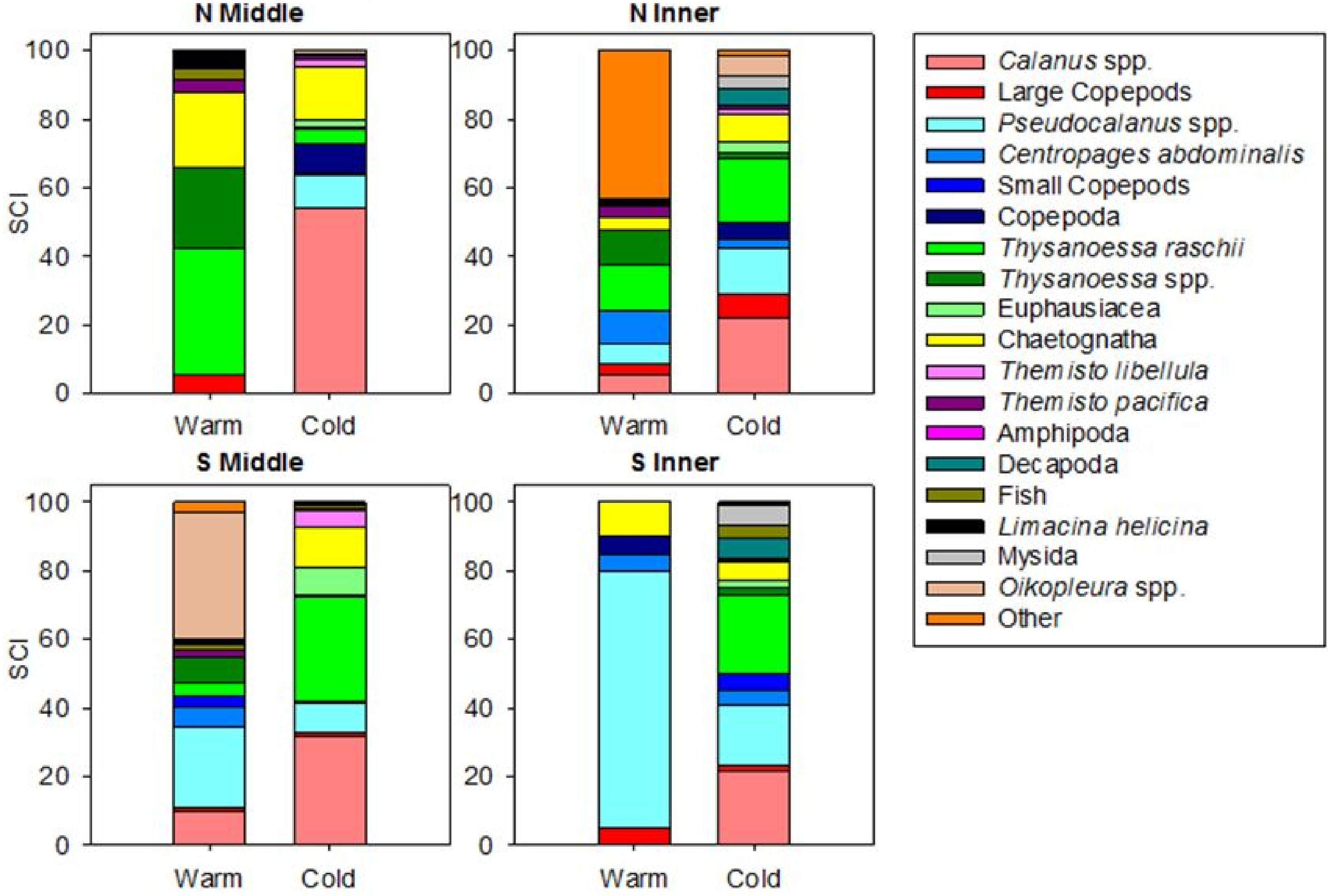
Herring:

More stable distribution between climate periods



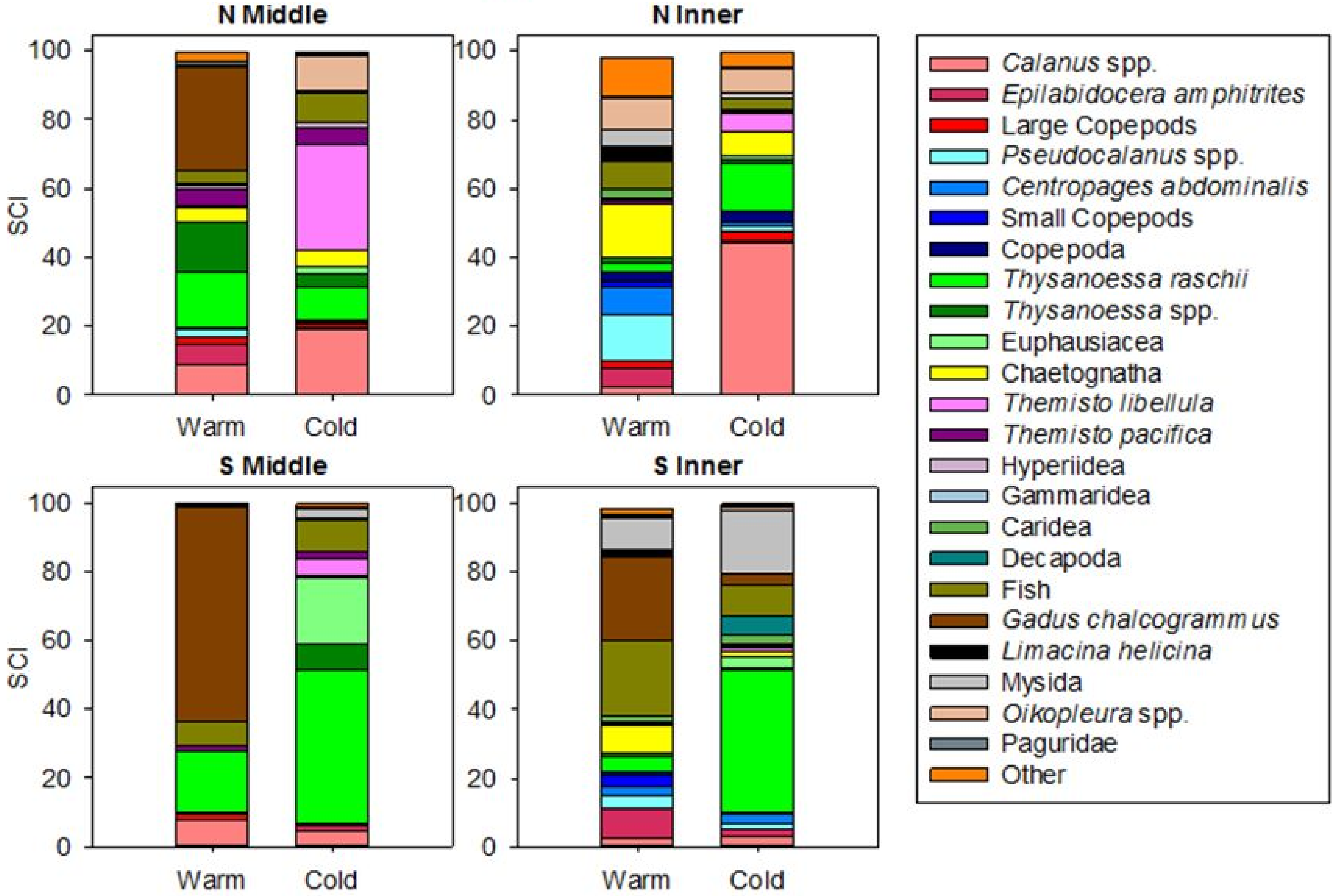
Andrews et al., in press

Capelin Diets

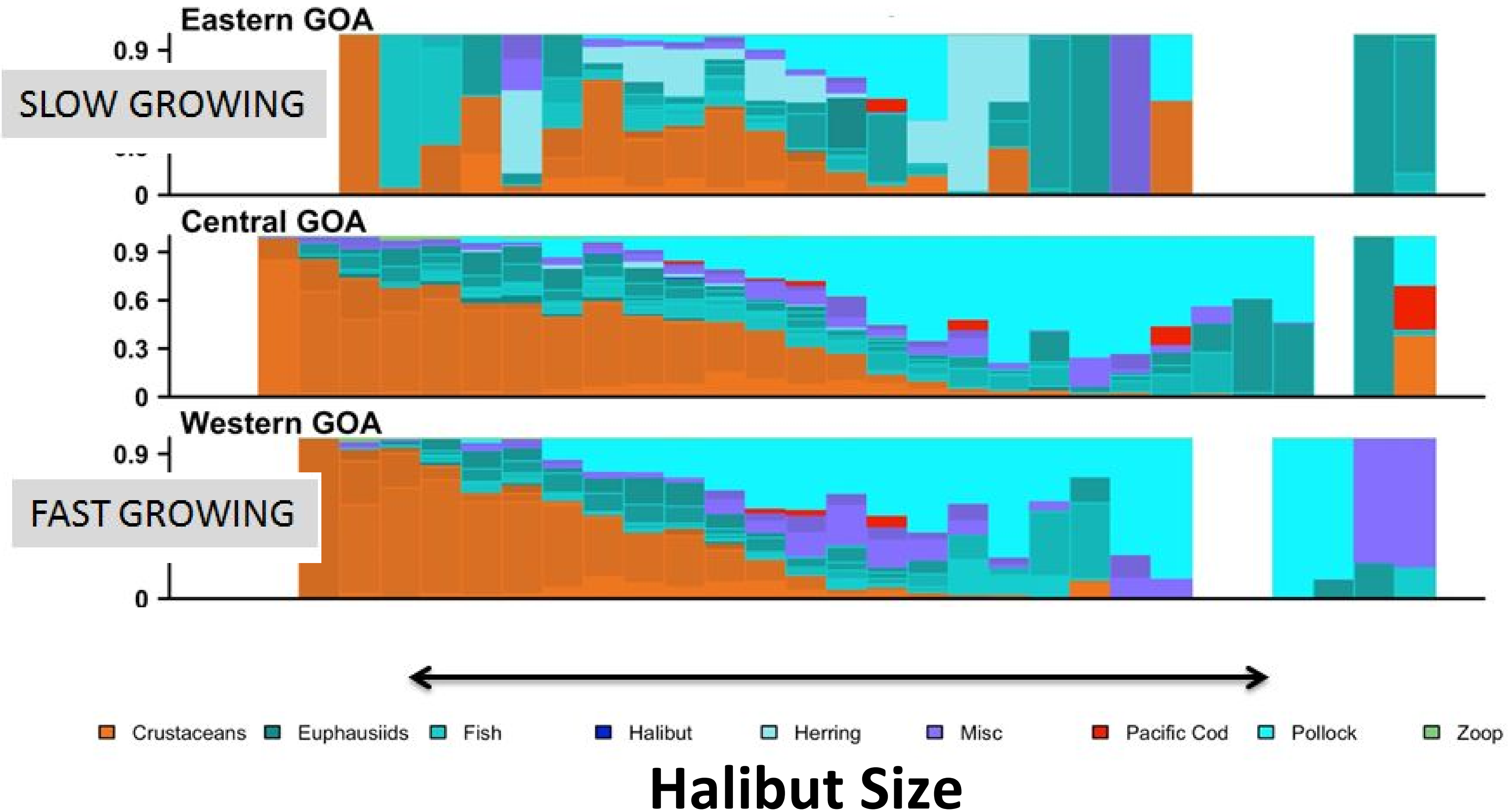


Andrews et al., in press

Herring Diets



Halibut Diets Vary by Region



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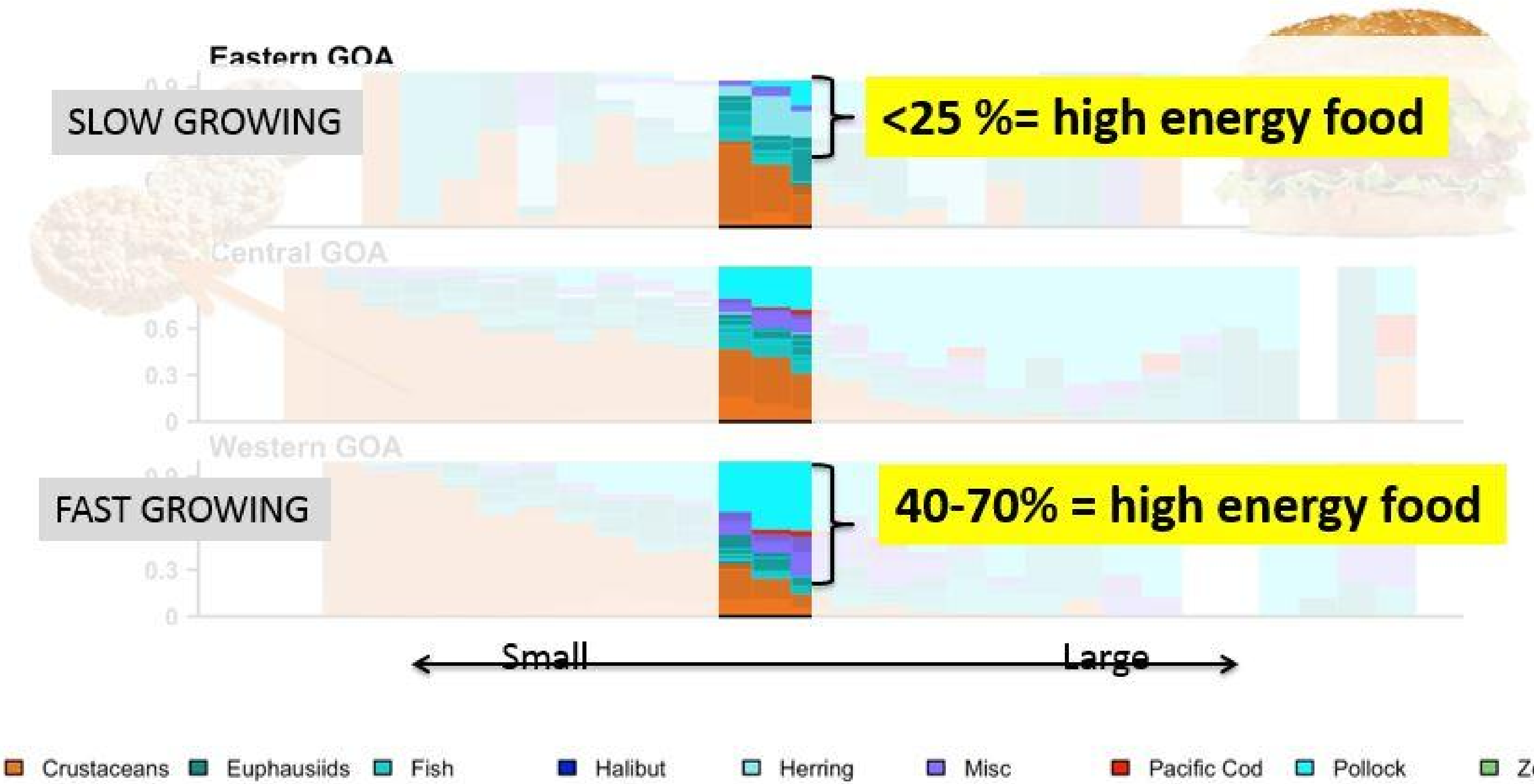
Halibut Diets Vary by Region



Halibut Size

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- Status of ecosystem data
- Strategies to obtain/manage data
- Inclusion into management
- Peer-review
- Communication

Communication to managers and public

AFSC News

March 28, 2016

Contact: Maggie Mooney-Seus
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206-526-4348 (office), 774-392-4865 (cell)

New Web Tools to Examine What Fish are Eating and Track Marine Ecosystem Trends

Let's see what's inside this cod's tummy? Photo credit: NOAA Fisheries

Most comprehensive database of Alaska predator diets; First ecosystem report card for Gulf of Alaska

Today, NOAA Fisheries officially rolled out two new databases that make it easy to access comprehensive, long-term diet data for key Alaska marine fish species and to track ecosystem trends for four large marine ecosystems that surround Alaska. Researchers can use these resources to more fully understand predator-prey relationships in the ocean and managers can use them to help sustainably manage marine resources.

Inclusion in management

- Both juvenile and adult food habits are primary data for creating & updating ecosystem models used in Council process (covered later).
- Cod diets used to set OFL for eastern Bering Sea Octopus.
- Diet-based ecosystem indicators for age-0 pollock foraging conditions, forage fish abundance.

December 2012 *BSAI Octopus*

22. Assessment of the Octopus Stock Complex in the Bering Sea and Aleutian Islands

M. Elizabeth Conners, Christina Conrath, and Kerim Aydin
Alaska Fisheries Science Center
November 2012

Executive Summary

Through 2010, octopuses were managed as part of the BSAI "other species" complex, along with sharks, skates, and sculpins. Historically, catches of the other species complex were well below TAC and retention of other species was small. Due to increasing market values, retention of some other species complex members is increasing. Beginning in 2011, the BSAI fisheries management plan was amended to provide separate management for sharks, skates, sculpins, and octopus and set separate catch limits for each species group. Catch limits for octopus for 2011 were set using Tier 6 methods based on the maximum historical incidental catch rate. For 2012, a new methodology based on consumption of octopus by Pacific cod was introduced; this method is also recommended for 2013 and 2014. The consumption estimate has not been revised from last year; the authors recommend that this calculation be revisited once every five years.

In this assessment, all octopus species are grouped into one assemblage. At least seven species of octopus are found in the BSAI. The species composition of the octopus community is not well documented, but data indicate that the giant Pacific octopus *Enteroctopus dofleini* is most abundant in shelf waters and predominates in commercial catch. Octopuses are taken as incidental catch in trawl, longline, and pot fisheries throughout the BSAI; a portion of the catch is retained or sold for human consumption or bait. The highest octopus catch rates are from Pacific cod fisheries in the three reporting areas around Unimak Pass. The Bering Sea and Aleutian Island trawl surveys produce estimates of biomass for octopus, but these estimates are highly variable and do not reflect the same sizes of octopus caught by industry. Examination of size frequency from survey and fishery data shows that both commercial and survey trawls catch predominantly small animals (<5 kg), while commercial pot gear catches or retains only larger animals (10-20 kg). In general, the state of knowledge about octopus in the BSAI is poor. A number of research studies and special projects have been initiated in recent years to increase knowledge for this assemblage; results of these studies are summarized.